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Quality and Cost of Ginning American-Egyptian Cotton

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Seasons 1952-53 and 1953-54

UNITED STATES DEPARTMENT OF AGRICULTURE
Agricultural Marketing Service
Marketing Research Division
Washington, D. C.
and
UNIVERSITY OF ARIZONA
Agricultural Experiment Station
Cooperating

Marketing Research Report No. 199

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ACKNOWLEDGMENTS

The portion of this study dealing with Arizona gins was planned and conducted cooperatively by the Agricultural Experiment Station, University of Arizona, and the Agricultural Marketing Service of the U. S. Department of Agriculture. It was under the general direction of Ralph S. Hawkins, Director of the Arizona Agricultural Experiment Station; George W. Barr, Head, Department of Agricultural Economics, University of Arizona; John W. Wright, Chief, Standards and Testing Branch, Cotton Division, AMS; and W. H. Fortenberry, Assistant Chief of the Branch and formerly in charge, Mesilla Park Cotton Laboratory, Mesilla Park, N.Mex. Data pertaining to gins located in the Trans-Pecos area of Texas and the Mesilla Valley of New Mexico were obtained by representatives of the U. S. Department of Agriculture.

The study was made possible by the cooperation of owners of roller gins in central Arizona, the Trans-Pecos area of Texas, and the Mesilla Valley of New Mexico who permitted use of their ginning facilities and financial records for the purposes of the study.

The authors also wish to thank Lloyd G. Crittendon and his staff, and Stanley C. Rademaker and Jack L. King, all of the Cotton Division, Agricultural Marketing Service, for classing the lint cotton samples.

Washington, D. C.

October 1957

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QUALITY AND COST OF GINNING AMERICAN-EGYPTIAN COTTON
Seasons 1952-53 and 1953-54

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SUMMARY AND CONCLUSIONS

During the 1952-53 and 1953-54 seasons, studies were conducted as to the quality and cost of ginning services at 13 of the 21 roller gins then located in Central Arizona, the Trans-Pecos area of Texas, and the Mesilla Valley of New Mexico. Gins by general geographic location (Arizona and Texas-New Mexico) were divided into groups according to amount of cleaning and conditioning equipment.

Measurable differences between the quality of ginning services performed by gins with simple, moderate, or elaborate equipment were relatively small except in the case of formation of neps (tiny tangled masses of fiber). The more elaborately equipped gins in each area appeared to be slightly more effective in removing foreign matter from machine-picked seed cotton than the more simply equipped gins. With regard to moisture content removal and other measures of performance there was no consistent pattern by gin groups.

The most significant difference in quality performance by machinery groups was that the cotton ginned on the elaborately equipped gins contained about twice as many neps as cotton handled by the simply equipped gins. For many end products for which extra long staples are commonly used, excessive neppiness of the raw cotton is more objectionable than a slight increase in foreign matter content.

As groups, the moderately and elaborately equipped gins had greater capacity and greater output per unit of capacity than the simply equipped gins and received much greater volumes of cotton. Both the simply equipped and the moderately equipped gins in Arizona processed cotton at rates of only about 1.2 bales per hour at costs of about $20 to $22 per bale and $22 to $25 per bale, respectively. In the Texas-New Mexico area, the moderately and elaborately equipped gins turned out about 2 bales per hour of operation at costs of from approximately $17 to $19 per bale and $15 to $19 per bale, respectively. This cost advantage on the part of gins in the Texas-New Mexico area, which would be expected from volumes that were 1-1/2 to 2

1/ Mr. St. Clair was with the University of Arizona, Tucson, Ariz., during the initial stages of the research; he was then with the U. S. Department of Agriculture until August 1957 when he resigned.

times greater than those of the Arizona gins, actually was not as significant as indicated since wage rates in the former area were only about three-fourths as high as those in the latter area.

Break-even points, where ginning revenues equal ginning costs, were about 1,750 bales for the Central Arizona gins and 2,750 bales for the Texas-New Mexico gins. The lower average break-even volumes required by the Arizona group of gins were attributable to their lower fixed costs and higher ginning revenues per bale. Despite the relatively high break-even point of the more modern Texas-New Mexico gin group, net returns per bale of those gins were about double those of the Arizona gins during the 2 seasons because of the larger volumes of cotton ginned.

Results of the study did not provide a sufficient basis for unqualified recommendations but they did highlight some points that merit consideration. Within the limits of equipment combinations represented by gins in this study, additional equipment tended to improve performance to a small degree in the ginning of machine-picked cotton but provided slightly less satisfactory results in the handling of handpicked cotton and significantly increasing neppiness of the cotton as compared with the simply equipped gins. Assuming a situation where hand- and machine-picked cotton were to be received in about equal proportions, gins similar to the moderately equipped gins in Texas-New Mexico appeared to be the most satisfactory compromise for general service when all recorded results were appraised. These gins were equipped with one drier, one overhead cleaner, and modern gin stands with an extractor-feeder over each stand.

INTRODUCTION

American-Egyptian cotton is an extra long staple crop grown almost exclusively in Arizona, the Trans-Pecos section of Texas, and the Mesilla Valley of New Mexico. This cotton generally provides staples ranging in length from 1-3/8 to 1½ inches. It is ginned on roller gins.

Production of this relatively small but highly strategic crop has varied fantastically throughout its history. In 1920-21, ginnings reached about 92,600 bales but by 1924-25 they had declined to approximately 4,300 bales. During World War II production expanded to a peak of about 73,800 bales in 1942-43 only to retreat to a near vanishing point of approximately 1,200 bales by 1947-48. Under stimulus of the Korean emergency, a record crop of about 93,500 bales was harvested in 1952-53. Since then production has declined somewhat.

Advances in the ginning of American-Egyptian cotton have not been as rapid as those in ginning upland cotton for three reasons: (1) Relatively small and undependable volumes have made it risky for roller gin owners to erect new plants or modernize old ones; (2) the same factor has made it uneconomic for gin manufacturers to devote resources to the development and

manufacture of new types of roller gin equipment; and (3) many gin owners have questioned the extent to which American-Egyptian cotton can be subjected to machining without damaging its quality.

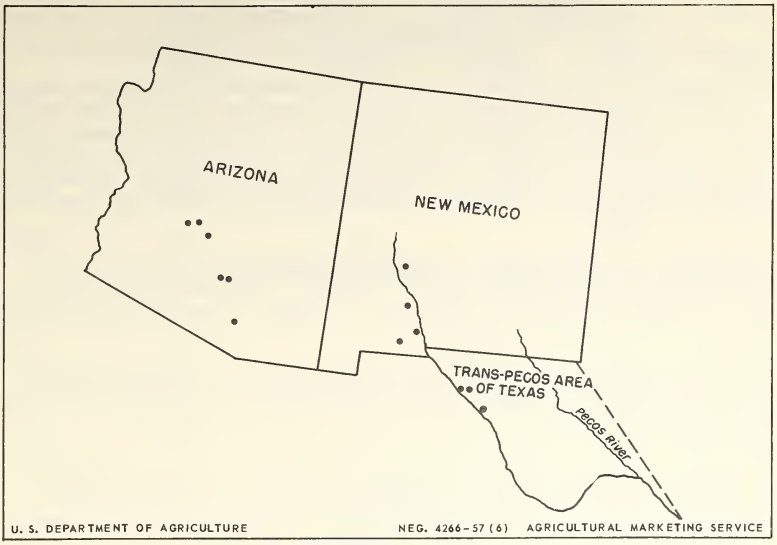


Figure 1.--Location of roller gins cooperating in study, seasons of 1952-53 and 1953-54

Increases in the amount of cotton, however, have induced some ginners to experiment with greater use of cleaning and drying equipment in an effort to speed up ginning and to improve the quality of the lint. Attention to roller ginning techniques has been stimulated, also, by a potentially widening market for American-Egyptian cotton. The newest variety, Pima S-1 (Supima), has attracted growers by its higher yields, and spinners by its excellent spinning performance. Adjustments in prices for such cotton have added to its interest for cotton mills.

PURPOSE OF STUDY

This study compares the quality of services and the costs of some of the newer, more elaborately equipped plants with those of gins with only a moderate amount of cleaning equipment, and also some older gins with very simple equipment. Performance is compared both for hand-picked and machine-picked cotton, because the type of gin equipped to do the best job on machine-picked cotton may not be most suitable for hand-picked cotton, and vice versa.

Costs per bale for each kind of gin are compared. An indication is given of the relationship between costs and volume. Net returns and break-even points are derived.

PROCEDURE

Thirteen gins were selected out of 21 in operation in the area studied at the time this project was begun. This area embraces the Trans-Pecos area of Texas, the Mesilla Valley of New Mexico, and central Arizona (fig. 1). Gins were divided into four groups of elaborately, moderately (two groups), and simply equipped cotton gins. The four groups, according to geographical location and the amount of overhead cleaning and conditioning equipment installed, are as follows:

Elaborately Equipped Plants (New Mexico-Texas) had a big reel or a tower drier, an inclined or impact cleaner, 4 to 6 extractor-feeders used as overhead cleaning equipment, and plain feeders or extractor-feeders over each stand (fig. 2).

Moderately Equipped Plants (New Mexico-Texas) had a big reel drier, a jumbo or inclined cleaner, and standard extractor-feeders over each stand (fig. 2).

Moderately Equipped Plants (Arizona) had a tower or big reel drier, an inclined cleaner, 2 extractor-feeders used as overhead cleaning equipment, and 3-cylinder cleaner-feeders or plain feeders over each stand (fig. 3).

Simply Equipped Plants (Arizona) had either a tower drier or heat on the feeders, 2 extractor-feeders for overhead cleaning, and plain feeders over each stand (fig. 3).

Subdividing information obtained from only 13 gins into 4 sets of figures greatly limited the size of the sample representing each group. Such gins, however, did differ significantly in type and amount of equipment and the study included very nearly two-thirds of all roller gins in the entire area.

During weekly sampling trips throughout the 1952-53 and 1953-54 seasons, cotton samples were taken at various stages of the ginning process in order to determine the effect of various gin machinery setups upon cotton quality (table 1). Seed cotton and lint samples were subjected to laboratory tests, and lint samples were classified. At the conclusion of each season, detailed cost records were obtained from cooperating gins.

Table 1.--Bales of cotton sampled: American-Egyptian gins, by gin equipment group and method of harvest, 1952-53 and 1953-54

Season and method of harvest	Texas-New Mexico gins, equipped--		Central Arizona gins, equipped--		Total
	Elaborately	Moderately	Moderately	Simply	
	Number	Number	Number	Number	Number
1952-53					
Hand	107	99	39	58	303
Machine	28	4	48	28	108
Total	135	103	87	86	411
1953-54					
Hand	102	70	100	51	323
Machine	15	17	56	8	96
Total	117	87	156	59	419

QUALITY OF GINNING SERVICES

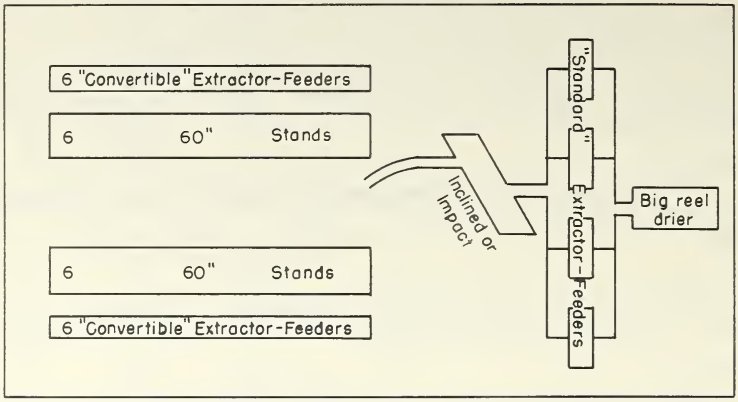
Foreign Matter Content and Removal

The average trash content of seed cotton as it came to the gins varied among groups from 4 to 12 percent (table 2). Among individual bales the range was much wider, from 2 to 44 percent. By the time this seed cotton had passed through the cleaners, driers, and feeders and was ready to be ginned, trash content had been reduced to from 0.9 to 2.7 percent, depending upon the gin group and method of harvest.

One purpose of this study was to determine which gin equipment group was most efficient in foreign matter removal. Computations were made of the proportion of original-trailer foreign matter which had been removed by the time the feeder sample was taken (table 3). The variable quality of the trash content of the seed cotton received at the different gins limits the validity of the conclusions that can be drawn from this analysis but the data may give a rough indication of the relative efficiencies of elaborate versus moderate and simple gin setups in trash removal.

ELABORATELY AND MODERATELY EQUIPPED ROLLER GINS, TEXAS-NEW MEXICO VALLEY

Elaborately Equipped Gin



Moderately Equipped Gin

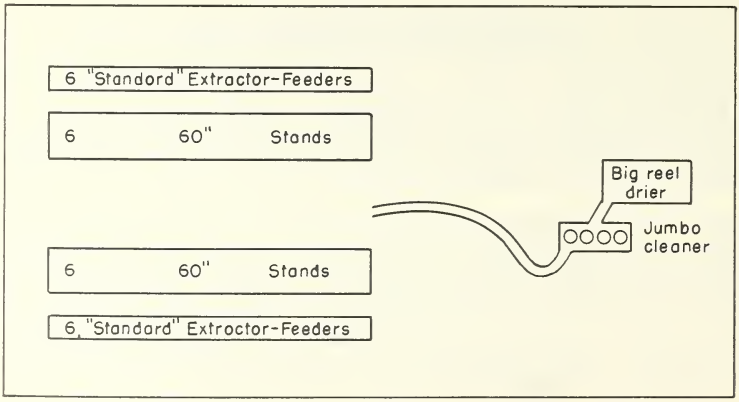


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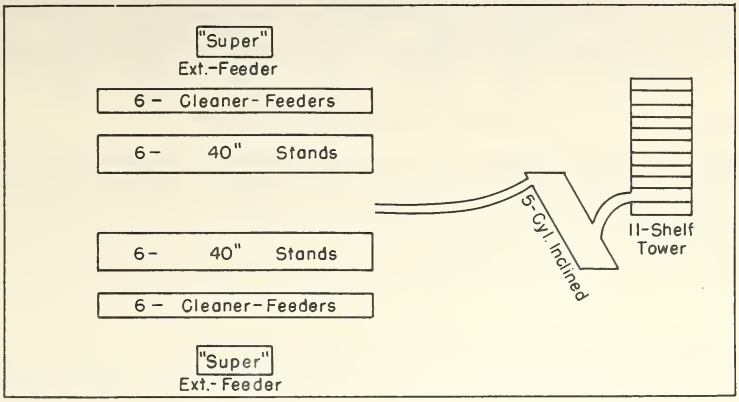
Figure 2

MODERATELY AND SIMPLY EQUIPPED ROLLER GINS IN CENTRAL ARIZONA

Moderately Equipped Gin



Simply Equipped Gin

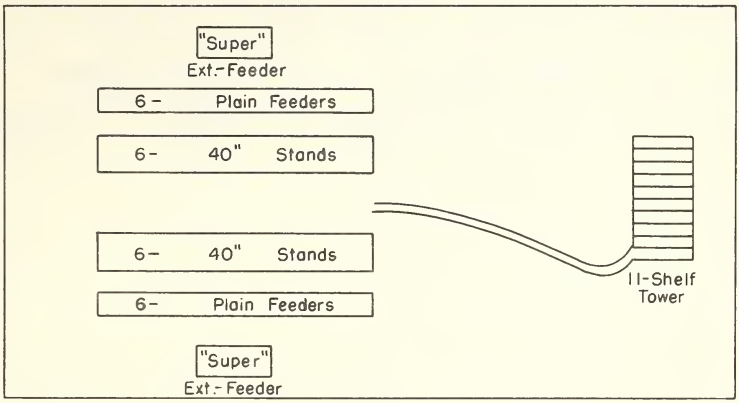


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Figure 3

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Table 2.--Foreign matter: Percentage in selected samples of American-Egyptian seed cotton as received on truck or trailer at the gin, and at gin stand, after cleaning immediately prior to ginning, by gin equipment group and method of harvest, 1952-53 and 1953-54

Season and method of harvest	Texas-New Mexico gins, equipped--				Central Arizona gins, equipped--			
	Elaborately		Moderately		Moderately		Simply	
	On truck	At gin stand	On truck	At gin stand	On truck	At gin stand	On truck	At gin stand
	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
1952-53								
Hand	4.2	0.9	4.3	0.7	12.2	2.7	5.5	0.8
Machine	9.4	2.0	1/	1/	8.4	2.0	5.8	2.0
1953-54:								
Hand	6.0	1.0	4.4	.8	8.3	1.3	7.1	.9
Machine	5.7	1.4	3.8	1.1	4.4	1.2	1/	1/

1/ Insufficient data.

Table 3.--Original foreign matter: Proportion removed from American-Egyptian seed cotton, by gin equipment group and method of harvest, 1952-53 and 1953-54

Season and method of harvest	Texas-New Mexico gins, equipped--		Central Arizona gins, equipped--	
	Elaborately	Moderately	Moderately	Simply
	Percent	Percent	Percent	Percent
1952-53				
Hand	79	84	78	85
Machine	79	1/	76	66
1953-54:				
Hand	83	82	84	87
Machine	75	71	73	1/

1/ Insufficient data.

The differences were not great--usually just a few percentage points between groups. On hand-harvested cotton, the simply equipped gins did a slightly better job in both seasons, removing 85 and 87 percent of the original trash in 1952-53 and 1953-54, respectively. In the case of machine harvested cotton which had more finely ground trash and wet spots, the elaborately equipped gins showed a slight advantage. They removed 79 percent of the original trash in 1952-53 and 75 percent in 1953-54, the highest removal of any group. In general, however, trash removal was related as closely to the original trash content of the seed cotton as to gin equipment groups; the trashier the seed cotton, the greater the amount of trash removed.

Moisture Content and Removal

Excess moisture in seed cotton is a problem mainly because it makes it more difficult for the cleaners to do their work. The average moisture content of hand-harvested cotton as it came to the gin varied among groups from about 7.5 to 8.5 percent in 1952-53 and from 6.5 to 7 percent in 1953-54 (table 4). Machine harvested seed cotton contained more moisture in both years, ranging by gin equipment groups from 8 to 12 percent in 1952-53 and 8 to 10 percent in 1953-54.

Table 4.--Moisture content: Percentage in selected samples of American-Egyptian seed cotton as received on truck or trailer at the gin, and at gin stand, after cleaning immediately prior to ginning, by gin equipment group and method of harvest, 1952-53 and 1953-54

Season and method of harvest	Texas-New Mexico gins, equipped--				Central Arizona gins, equipped--			
	Elaborately		Moderately		Moderately		Simply	
	On truck	At gin stand	On truck	At gin stand	On truck	At gin stand	On truck	At gin stand
	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
1952-53								
Hand	7.5	7.5	7.4	6.7	8.5	8.1	7.8	7.3
Machine	8.3	7.8	1/	1/	10.1	8.5	11.8	10.3
1953-54								
Hand	6.9	6.6	6.6	6.5	6.5	6.2	6.6	6.0
Machine	8.1	7.6	9.7	8.7	8.4	6.9	1/	1/

1/ Insufficient data.

Moisture samples of hand-harvested cotton taken at the gin stand were only slightly drier than those taken off the truck. This indicates that driers were not used or used at very low temperatures. Moisture does not become much of a problem in American-Egyptian cotton until it exceeds 7.5 percent; most of the hand harvested samples taken both on the truck and at the gin stand were below that level.

In the case of machine-harvested cotton, the samples taken at the gin stand were considerably drier than the truck samples. Some seed cotton that had tested 10 percent moisture on the truck was reduced to 8.5 percent at the gin stand. For another gin group, cotton that had contained nearly 12 percent moisture on the truck contained less than 10.5 percent at the gin stand.

Moisture removal, like trash removal, is one of the traditional measures of gin efficiency. Since all groups had approximately the same drying equipment, differences in performance were mainly a matter of differences in utilization of such equipment. Most of the gins had either a big-reel or an 11-shelf tower drier.

The moderately equipped gins of Texas-New Mexico removed the highest proportion of original moisture from hand harvested cotton in 1952-53, while the simply equipped Arizona gins removed the highest proportion in 1953-54. In both cases the proportion removed was about 9 percent (table 5). Machine harvested cotton contained more moisture than hand harvested cotton when brought to the gin and a higher proportion generally was removed by the driers. In both years the moderately equipped Arizona gins removed a greater proportion of the original moisture from machine harvested seed cotton than any other group--16 percent and 18 percent in 1952-53 and 1953-54, respectively

Table 5.--Original moisture content: Proportion removed from American-Egyptian seed cotton, by gin equipment group and method of harvest, 1952-53 and 1953-54

Season and method of harvest	Texas-New Mexico gins, equipped--		Central Arizona gins, equipped--	
	Elaborately	Moderately	Moderately	Simply
	Percent	Percent	Percent	Percent
1952-53				
Hand	0	9	5	6
Machine	6	1/	16	13
1953-54				
Hand	4	2	5	9
Machine	6	10	18	1/

1/ Insufficient data.

Lint moisture content was about the same for all equipment groups and methods of harvest. The simply equipped gins produced the driest lint from hand-harvested cotton in both years. This lint contained 3.9 percent moisture in 1952-53 and only 3.3 percent moisture in 1953-54 (table 6). In the case of machine-harvested cotton, the moderately equipped Arizona gins produced the driest lint of any group--4.6 percent moisture and 3.6 percent moisture in 1952-53 and 1953-54, respectively.

Table 6.--Moisture content: Percentage in selected samples of American-Egyptian lint cotton, by gin equipment group and method of harvest, 1952-53 and 1953-54

Season and method of harvest	Texas-New Mexico gins, equipped--		Central Arizona gins, equipped--	
	Elaborately	Moderately	Moderately	Simply
	Percent	Percent	Percent	Percent
1952-53				
Hand	5.2	4.8	4.9	3.9
Machine	5.3	1/	4.6	5.8
1953-54				
Hand	4.7	4.5	3.6	3.3
Machine	4.7	5.6	3.6	1/

1/ Insufficient data.

Grade of Lint Cotton

Although the grade of lint cotton is determined largely by growing and harvesting practices, ginning machinery and practices also may have considerable effect. 2/ Few differences were noted in the quality of cotton lint from hand-harvested cotton by the four gin groups. Grade averages by gin equipment groups ranged from 1.8 to 2.6 on the basis of the official standards for American-Egyptian cotton (table 7). Excepting some dirty, wet seed cotton received by one group, the range for hand-harvested cotton was only from 1.8 to 2.1. The highest grade index for hand-harvested cotton, 1.8, was achieved

2/ Official grade standards for American-Egyptian cotton include 9 grades, ranging from a high of grade No. 1 to a low of grade No. 9. Although grade steps in cotton are not uniform, a rough index of grade levels may be calculated by averaging these numerical designations. In the convenient index obtained by a simple average of such grade designations, the lower the index number the higher the grade represented.

by Arizona's simply equipped gins in the 1952 season, and by its moderately equipped group in 1953-54.

Table 7.--Grade index: Averages for selected samples of American-Egyptian lint cotton, by gin equipment group and method of harvest, 1952-53 and 1953-54

Season and method of harvest	Texas-New Mexico gins, equipped--		Central Arizona gins, equipped--	
	Elaborately	Moderately	Moderately	Simply
	Points	Points	Points	Points
1952-53				
Hand	2.0	1.9	2.6	1.8
Machine	4.0	1/	4.7	5.2
1953-54				
Hand	2.1	1.9	1.8	2.0
Machine	3.2	3.3	2.9	1/

1/ Insufficient data.

Differences among groups in grades produced from machine-harvested cotton were larger. Levels of grade ranged from 2.9 to 5.2. But the pattern among groups was no more consistent. In 1952-53 the elaborately equipped gins produced the highest grade index from machine-picked cotton--4.0. In 1953-54 the moderately equipped Arizona gins produced the highest grade--2.9.

Non-lint Content of Ginned Lint

Non-lint content of ginned lint is a measure of the amount of trash that passes through the cleaning machinery and into the bale. Determined on the Shirley Analyzer, it gives some indication of the amount of processing loss that can be expected when the cotton is processed in a spinning mill.

Differences in non-lint content between methods of harvest tended to be somewhat larger than differences among gin groupings. Non-lint content of machine-harvested cotton was consistently greater than that of hand-harvested cotton at the same group of gins.

The average non-lint content of ginned cotton ranged among groups from 3.5 to 5.5 percent for hand-harvested cotton, and from 5 to 7 percent for machine-harvested cotton (table 8). The moderately equipped gins of Texas-New Mexico tied the simply equipped Arizona gins for production of the

cleanest lint from hand-harvested cotton in 1952-53. Both groups produced lint of 3.6 percent non-lint content. In 1953-54, the moderately equipped group of Arizona gins produced lint from hand-harvested cotton containing only 3.5 percent non-lint content.

In the case of machine-harvested cotton, the moderately equipped Arizona group produced slightly cleaner cotton in both seasons. This cotton contained 6.7 percent and 5.1 percent non-lint in 1952-53 and 1953-54, respectively.

Table 8.--Non-lint content: Percentage in selected samples of American-Egyptian lint cotton, by gin equipment group and method of harvest, 1952-53 and 1953-54

Season and method of harvest	Texas-New Mexico gins, equipped--		Central Arizona gins, equipped--	
	Elaborately	Moderately	Moderately	Simply
	Percent	Percent	Percent	Percent
1952-53				
Hand	3.8	3.6	5.4	3.6
Machine	7.0	1/	6.7	6.8
1953-54				
Hand	4.4	4.1	3.5	3.7
Machine	5.7	5.3	5.1	1/

1/ Insufficient data.

Nep Count

Neps are tiny, tangled masses of fibers found in lint cotton. They often persist through the woven fabric stage, detracting from the appearance of the fabric and its ability to take dye uniformly.

Tests on 137 samples of American-Egyptian cotton in the 1953-54 season showed that the gins with the greatest amount of cleaning machinery tended to produce cotton with the greatest number of neps (table 9). The method used in determining these nep counts was a comparatively rapid approach normally used in testing medium staple upland cotton. The recorded nep counts, therefore, are greatly in excess of what these same lots would have yielded in actual processing performance. The data, however, while not indicative of the true level of nep counts, do provide a valid basis of comparison between machinery groups and show that the average number of neps for cotton ginned on elaborately equipped gins was about twice as great as on the simply equipped gins.

Table 9.--Neps: Number counted in webs prepared from selected lots of American-Egyptian lint cotton, by gin equipment group, 1952-53 and 1953-54 1/

Nep count	Texas-New Mexico gins, equipped--		Central Arizona gins, equipped--	
	Elaborately	Moderately	Moderately	Simply
	Lots	Lots	Lots	Lots
6 to 10	3	5	7	10
11 to 15	8	10	26	11
16 to 20	5	7	14	1
21 to 25	8	6	1	-
26 and greater	12	2	1	-
Total	36	30	49	22
Average	23.1	16.7	14.3	10.7

1/ The neps per 100 square inches of a web prepared from a 3-gram sample of cotton lint on special small-scale equipment producing the equivalent of a 40-grain sliver processed at a carding rate of 9½ pounds per hour.

Ranking of Gins According to Quality of Services Performed

To determine which machinery setup was doing the best job over the 2-year period, rankings were made of the four gin equipment groups in respect to five selected factors which indicate differences in quality of ginning services. Factors considered were: (1) Foreign matter removal, (2) moisture removal, (3) grade, (4) non-lint content of ginned lint, and (5) nep count.

With hand-harvested cotton, one type of gin appeared to do the best job; with machine-harvested cotton another gin group demonstrated superiority. If, as is usually the case, a gin has to handle both hand- and machine-harvested cotton the most desirable cleaning setup is likely to be a compromise.

The simply equipped gins showed some advantages over the other groups when dealing with hand-harvested cotton (table 10). This group of gins ranked first for all five quality factors. At the other extreme were the elaborately equipped gins that ranked third or fourth in respect to each of the factors considered. Moderately equipped gins fell between these extremes.

When quality of services performed on machine-harvested cotton was considered, a different ranking of gins resulted. In this case the moderately equipped groups generally ranked ahead of both the elaborately and the simply equipped groups (table 11).

Table 10.--Hand-harvested cotton: Gin groups ranked according to service performed, 1952-53 and 1953-54

Quality factor	Unit	Texas-New Mexico gins, equipped--				Central Arizona gins, equipped--			
		Elaborately		Moderately		Moderately		Simply	
Foreign matter removal	Percent	81	(3-4) 1/	83	(2)	81	(3-4)	86	(1)
Moisture removal	Percent	2	(4)	6	(2)	5	(3)	8	(1)
Grade index	Points	2.0	(3)	1.9	(1-2)	2.2	(4)	1.9	(1-2)
Non-lint content of ginned lint	Percent	4.1	(3)	3.8	(2)	4.4	(4)	3.6	(1)
Nep count 2/	Number	23.1	(4)	16.7	(3)	14.3	(2)	10.7	(1)

1/ ( ) = rank
2/ Nep results are for hand- and machine-harvested combined. Separate results are not available.

Table 11.--Machine-harvested cotton: Gin groups ranked according to service performed, 1952-53 and 1953-54

Quality factor	Unit	Texas-New Mexico gins, equipped--				Central Arizona gins, equipped--			
		Elaborately		Moderately		Moderately		Simply	
Foreign matter removal	Percent	77	(1) 1/	71	(3)	75	(2)	66	(4)
Moisture removal	Percent	6	(4)	10	(3)	17	(1)	13	(2)
Grade index	Points	3.6	(2)	3.3	(1)	3.8	(3)	5.2	(4)
Non-lint content of ginned lint	Percent	6.4	(3)	5.3	(1)	5.9	(2)	6.8	(4)
Nep count 2/	Number	23.1	(4)	16.7	(3)	14.3	(2)	10.7	(1)

1/ ( ) = rank
2/ Nep results are for machine- and hand-harvested combined. Separate results are not available.

Since most gins must handle both machine-picked and hand-picked cotton, a third set of rankings was made. These rankings were based upon the assumption that 50 percent of the cotton was hand-harvested and 50 percent was machine-harvested. Under these conditions the moderately equipped gins generally ranked higher than other groups (table 12).

Table 12.--Hand- and machine-harvested cotton: Gin groups ranked according to service performed, 1952-53 and 1953-54 1/

Quality factor	Unit	Texas-New Mexico gins, equipped--				Central Arizona gins, equipped--			
		Elaborately		Moderately		Moderately		Simply	
Foreign matter removal	Percent	79	(1)	77	(3)	78	(2)	76	(4)
Moisture removal	Percent	4	(4)	8	(3)	11	(1)	10	(2)
Grade index	Points	2.8	(2)	2.6	(1)	3.0	(3)	3.6	(4)
Non-lint content of ginned lint	Percent	5.2	(2-3-4)	4.6	(1)	5.2	(2-3-4)	5.2	(2-3-4)
Nep count	Number	23.1	(4)	16.7	(3)	14.3	(2)	10.7	(1)

1/ Assumes one-half hand-harvested and one-half machine-harvested.
2/ ( ) = rank.

There was little difference between the two moderately equipped groups from a quality of services standpoint. When the greater ginning speed of the moderately equipped Texas-New Mexico group is taken into account, this type of plant would probably get the preference for general duty service, where both hand- and machine-harvested cotton are to be processed.

COST OF GINNING SERVICES

The cost of ginning services varied among gin equipment groups much more than the quality of services performed. Differences in per-bale costs were related primarily to variations in capacity, volume of ginnings, speed of turnout, and wage rates. During the study period gins located in the Texas-New Mexico area had an advantage over the Central Arizona gins in respect to 4 factors: (1) Their roller capacity averaged about one-third greater, (2) they received 40 percent more seed cotton per unit of roller capacity, (3) ginned it 22 percent faster, and (4) paid wages at rates that averaged only three-fourths as high as those in the Central Arizona gins. Comparisons between unit costs of the 4 gin equipment groups, therefore, should be made with these points in mind.

Speed and Capacity of Plants

The elaborately equipped Texas-New Mexico plants produced just over a thousand pounds of lint per hour, and the moderately equipped plants of this region just under a thousand (table 13). This is 60 to 70 percent greater production during actual operation than that achieved by the moderately equipped and simply equipped Central Arizona plants.

Table 13.--Lint processed: Production per plant per hour, American-Egyptian gins, by gin equipment group, 1952-53 and 1953-54

Season	Texas-New Mexico gins, equipped--		Central Arizona gins, equipped--	
	Elaborately	Moderately	Moderately	Simply
	Pounds	Pounds	Pounds	Pounds
1952-53	1,008	984	590	590
1953-54	1,008	989	629	633

There were two reasons for this difference: First, the Texas-New Mexico gins had greater capacity in terms of inches of roller per plant than did the Arizona gins. This was a particularly important factor for the moderately equipped Texas-New Mexico gins, which averaged over 700 inches of roller capacity compared with 480 in the Arizona gins (table 14).

Table 14.--Roller capacity: American Egyptian gins, by gin equipment group, 1952-53 and 1953-54

Season	Texas-New Mexico gins, equipped--		Central Arizona gins, equipped--	
	Elaborately	Moderately	Moderately	Simply
	Inches	Inches	Inches	Inches
1952-53	587	706	480	480
1953-54	587	706	480	480

The second reason for the greater hourly production of the Texas-New Mexico gins was their greater efficiency in terms of pounds of lint per roller-inch per hour. This is particularly important in the case of the elaborately equipped group which had an output of 1.7 pounds of lint per inch of roller in operation per hour, compared with 1.2 to 1.3 pounds for the Arizona groups (table 15).

Table 15.--Lint output per roller-inch per hour: American-Egyptian gins, by gin equipment group, 1952-53 and 1953-54

Season	Texas-New Mexico gins, equipped--		Central Arizona gins, equipped--	
	Elaborately	Moderately	Moderately	Simply
	Pounds	Pounds	Pounds	Pounds
1952-53	1.72	1.39	1.23	1.23
1953-54	1.72	1.40	1.31	1.32

The cause of this difference in efficiency seems to lie in the cleaning equipment, particularly in the feeders. Several gins of the elaborately and moderately equipped Texas-New Mexico group had feeders of high capacity and modern design. On the other hand, certain gins in the Arizona groups were equipped with obsolete feeders which did not supply seed cotton to the stands as rapidly as the modern feeders. The installation of improved feeders at such gins might increase the hourly output appreciably.

Total and Bale Ginning Costs

During the 1952-53 season the elaborately equipped gins of Texas and New Mexico operated at the lowest unit costs--about $15 per bale (table 16). The moderately equipped gins of the same region were second with costs of $17 per bale. The simply and the moderately equipped Arizona gins had higher costs, averaging about $20 and $22 per bale, respectively.

Table 16.--Ginning cost: American-Egyptian cotton, per gin and per bale, by gin equipment group, 1952-53 and 1953-54

Season and item	Texas-New Mexico gins, equipped--				Central Arizona gins, equipped--			
	Elaborately		Moderately		Moderately		Simply	
	Per gin	Per bale	Per gin	Per bale	Per gin	Per bale	Per gin	Per bale
	Dol.	Dol.	Dol.	Dol.	Dol.	Dol.	Dol.	Dol.
1952-53								
Variable costs	59,728	11.96	67,354	14.27	39,560	17.74	47,618	16.06
Fixed costs	15,482	3.10	13,783	2.92	9,411	4.22	11,652	3.93
Total costs	75,210	15.06	81,137	17.19	48,971	21.96	59,270	19.99
Bales per gin (av.)	4,994		4,720		2,230		2,965	
1953-54								
Variable costs	50,458	14.60	46,420	14.47	29,538	18.85	32,579	16.69
Fixed costs	14,688	4.25	14,564	4.54	10,546	6.73	10,716	5.49
Total costs	65,146	18.85	60,984	19.01	40,084	25.58	43,295	22.18
Bales per gin (av.)	3,456		3,208		1,567		1,952	

The ranking of gins according to per bale ginning costs was the same during the 1953-54 season. Those of the elaborately equipped gins were lowest, followed by the moderately equipped Texas-New Mexico group; the simply

equipped Arizona group was next to the highest; and the moderately equipped Arizona group highest. During the second season the whole cost structure had risen. Consequently, instead of ranging from $15 to $22 per bale, costs ranged from $19 to $26 per bale.

Fixed Costs

Costs divide logically into two categories: (1) Fixed costs, which remain relatively constant in total amount whether the gin operates or not, and (2) variable costs, which tend to vary in total amount directly with the number of bales ginned.

Investment in gin plant and equipment forms the basis for two annual fixed costs: Depreciation and interest on investment. It also directly affects the costs of insurance and taxes.

There were considerable differences in gin investment between the Arizona and Texas-New Mexico gins. The total original cost per plant averaged from $58,000 to $65,000 per plant for the Arizona gins, and was approximately 50 percent higher than this for the Texas-New Mexico groups (table 17). The explanation of this is that several of the Texas-New Mexico gins are newer and contain a larger amount of cleaning equipment than the gins in Arizona. A few Arizona gins still utilize gin stands and other components which originally were used in the Sea Island cotton growing areas of the United States. In other words, the equipment was secondhand even at the time the gin was erected. The cost of equipment obtained in this manner was low by present standards.

Machinery and equipment were depreciated at an annual rate of 5 percent of original cost per year. All wood buildings were depreciated at 5 percent per year; wood-frame and steel covered buildings, 4 percent per year; and all steel buildings, 3 percent per year. Real estate was not depreciated. This resulted in average depreciations of approximately $4,200 per year for the moderately equipped Texas-New Mexico gins, $3,600 for the elaborately equipped gins, $2,700 for the simply equipped gins, and $2,500 for the moderately equipped Central Arizona gins (table 18).

Interest on investment was obtained by applying a straight 4 percent to the present or depreciated value. This resulted in a charge for interest on investment during the 1952-53 season as follows: approximately $2,400 for the elaborately equipped gins of Texas and New Mexico, $1,900 for the moderately equipped gins of the same area, and $1,600 and $1,200 per gin for the simply and moderately equipped Arizona gins, respectively. A similar relationship among groups continued in the 1953-54 season.

In arriving at the present value, we depreciated the value of the gins for a period of years depending upon chronological age and present condition of the gin, up to a maximum of 12 years. Some of the newest gins had been operated only 1 to 3 years, and were depreciated accordingly. Since the older gins were restored each summer (to the extent that a considerable

Table 17.--Original investment: American-Egyptian gins and equipment, by gin equipment group, 1952-53 and 1953-54

Season and item	Texas-New Mexico gins, equipped--		Central Arizona gins, equipped--	
	Elaborately	Moderately	Moderately	Simply
	Dollars	Dollars	Dollars	Dollars
1952-53				
Real estate	5,135	1,662	4,272	4,933
Buildings	15,250	16,892	17,667	17,667
Installed machinery	61,496	69,437	33,020	38,162
Office equipment	747	1,224	1,267	733
Transportation equipment	2,388	2,456	1,833	2,067
Total	85,016	91,671	58,059	63,562
1953-54				
Real estate	5,135	1,662	3,954	5,900
Buildings	15,250	16,892	17,000	19,000
Installed machinery	61,496	69,437	34,765	37,242
Office equipment	747	1,224	1,075	850
Transportation equipment	2,388	2,456	1,875	2,100
Total	85,016	91,671	58,669	65,092

Table 18.--Original investment, present value, depreciation and interest: American-Egyptian gins, by gin equipment group, 1952-53 and 1953-54

Season and item	Texas-New Mexico gins, equipped--		Central Arizona gins, equipped--	
	Elaborately	Moderately	Moderately	Simply
	Dollars	Dollars	Dollars	Dollars
1952-53				
Original investment	85,016	91,671	58,059	63,562
Present value	59,403	48,338	29,932	39,590
Estimated annual depreciation	3,611	4,193	2,513	2,675
Interest on investment	2,376	1,933	1,197	1,584
1953-54				
Original investment	85,016	91,671	58,669	65,092
Present value	55,680	44,136	30,912	38,607
Estimated annual depreciation	3,667	4,197	2,523	2,648
Interest on investment	2,227	1,765	1,236	1,544

proportion of their original capital value has been retained) they were not depreciated to the full extent of their chronological age. The present value of a number of the older gins, however, is less than one-half of the original value, even using moderate rates of annual depreciation.

Variable Costs

Variable costs are those costs which tend to vary in total amount directly with the number of bales ginned. Included in this category are labor, power, bagging and ties, drier fuel, repairs, gin and office supplies, compensation insurance, telephone and telegraph, travel and automobile, and miscellaneous expenses.

During the 1952-53 season the elaborately equipped gins of Texas and New Mexico had the lowest variable costs--$11.96 per bale (table 19). The moderately equipped gins of the same region were second with variable costs of $14.27 per bale. The simply and the moderately equipped Arizona gins had higher variable costs of $16.06 and $17.74 per bale, respectively. A similar relationship among gin groups continued in the 1953-54 season. The ranking of gins in order of variable costs is the same as that which was noted earlier for total costs per bale. The cost of labor alone ranges from $5 to $12 per bale, depending upon the gin equipment group considered. Labor is by far the greatest single item of ginning costs for American-Egyptian cotton. Therefore labor inputs and wage rates should be examined when looking for an explanation of ginning cost differences among groups.

During the 1952-53 season the elaborately equipped gins of Texas and New Mexico required only 6½ man-hours to gin a bale and the moderately equipped gins of that area only about 7 man-hours (table 20). By comparison, the simply equipped Arizona gins required nearly 8 man-hours and the moderately equipped gins of the same area almost 9½ man-hours. The same ranking among groups prevailed in the second season, but more man-hours were required by each group.

The elaborately equipped gins used less labor per bale because they ginned faster (more bales per hour), and thus made more complete utilization of their labor. They also had high annual volumes, so that the crew seldom had to be paid for time spent waiting for seed cotton to come to the gin.

Furthermore, because of differences in wage rates between areas, the average cost of gin labor per man-hour was considerably lower for the elaborately and moderately equipped groups of Texas and New Mexico than for the moderately and simply equipped groups of Central Arizona. The average hourly wage, which ranged from 77 to 85 cents per hour for the Texas and New Mexico gins, ranged from $1 to $1.20 for the gins located in Arizona. This factor, as well as the lower labor inputs per bale, contributed substantially to the much lower labor costs per bale enjoyed by the more elaborately equipped gins.

Table 19.--Ginning cost: Breakdown per bale for American-Egyptian cotton, by gin equipment group, 1952-53 and 1953-54

Cost item	1952-53 season				1953-54 season			
	Texas-New Mexico gins, equipped--		Central Arizona gins, equipped		Texas-New Mexico gins, equipped--		Central Arizona gins, equipped--	
	Elaborately	Moderately	Moderately	Simply	Elaborately	Moderately	Moderately	Simply
	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Variable costs								
Labor	4.98	6.02	11.01	9.52	6.32	6.04	11.25	9.53
Power	.95	.97	.71	.74	1.17	1.05	.83	1.10
Bagging and ties	2.68	3.15	2.52	2.66	2.58	2.55	2.47	2.38
Drying and sterilization	.20	.32	.07	.23	.22	.38	.14	.25
Repairs	1.92	2.11	2.10	1.48	2.74	2.50	1.63	1.26
Gin supplies	.18	.15	.10	.10	.17	.12	.30	.21
Office supplies	.16	.23	.08	.17	.11	.15	.08	.07
Compensation insurance	.45	.51	.94	.82	.80	1.17	1.58	1.58
Telephone and telegraph	.04	.05	.06	.05	.06	.08	.11	.10
Travel and automobile	.16	.55	.09	.09	.16	.15	.14	.13
Miscellaneous	.24	.21	.06	.20	.27	.28	.32	.08
Total variable costs	11.96	14.27	17.74	16.06	14.60	14.47	18.85	16.69
Fixed costs								
Management	1.08	0.88	1.03	0.76	1.52	1.39	1.93	1.54
Office salaries 1/	.56	.45	1.12	1.15	.64	.93	1.67	1.22
Depreciation	.72	.89	1.13	.90	1.06	1.31	1.61	1.36
Interest on investment	.48	.41	.54	.53	.64	.55	.79	.79
Insurance (general)	.20	.21	.25	.50	.29	.23	.56	.42
Taxes	.06	.08	.15	.09	.10	.13	.17	.16
Total fixed costs	3.10	2.92	4.22	3.93	4.25	4.54	6.73	5.49
Total all costs	15.06	17.19	21.96	19.99	18.85	19.01	25.58	22.18
Bales per gin (average)	4,994	4,720	2,230	2,965	3,456	3,208	1,567	1,952

1/ Includes salary of night watchman when applicable.

Table 20.--Ginning time required per bale: American-Egyptian cotton, by gin equipment group, 1952-53 and 1953-54

Season	Texas-New Mexico gins, equipped--		Central Arizona gins, equipped--	
	Elaborately	Moderately	Moderately	Simply
	Man-hours	Man-hours	Man-hours	Man-hours
1952-53.....	6.5	7.1	9.4	7.9
1953-54.....	7.4	7.5	10.1	9.5

Factors Affecting Ginning Costs

Given a plant of a certain capacity, the most effective thing a ginner can do to reduce his costs per bale is to obtain a greater annual volume of ginnings. Increased volume reduces cost per bale for two reasons: (1) Total fixed costs are spread over a greater number of bales; and (2) within the range in volumes covered by this study (1,500 to 6,000 bales), variable costs per bale are either constant or decrease as volume ginned increases.

The importance of increasing volume as a means of reducing ginning costs per bale is illustrated by the fact that all gins with volumes exceeding 5,000 bales had total costs of less than $16 per bale as contrasted with costs of about $24 to $30 per bale for gins handling less than 2,000 bales (fig. 4). Based on combined data for the two seasons, estimated costs varied with volume from a per-bale figure of $28.40 at 1,500 bales per season to around $14.40 per bale at a volume level of 6,500 bales. The estimated ginning cost per bale at different volumes in all the equipment groups during the 1952-53 and 1953-54 seasons combined was:

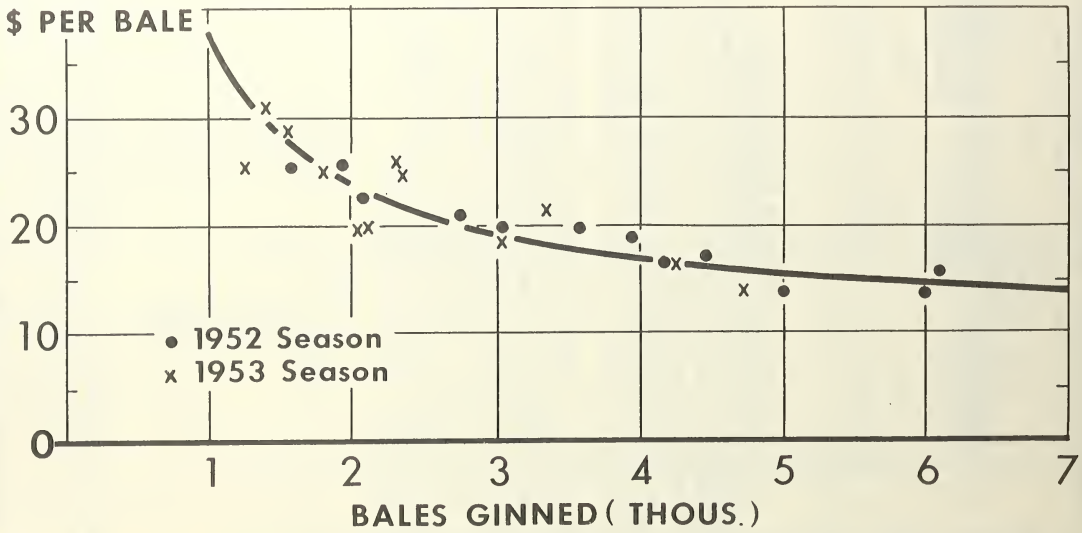
Bales ginned per year	Dollars per bale
1,500	28.40
2,000	23.90
3,000	19.30
4,000	17.00
5,000	15.60
6,000	14.70
6,500	14.40

A ginner cooperating in the study who operated at a seasonal level of 3,000 bales or less apparently would have reduced costs per bale by about 30 percent if he could have doubled his volume.

It is natural that the bigger, more elaborately equipped American-Egyptian plants should require more power and more fuel and thus cost more

*In Roller Gins in Texas, New Mexico, and Arizona**

RELATION BETWEEN VOLUME OF COTTON GINNED AND COST PER BALE



* TRANS-PECOS AREA OF TEXAS, MESILA VALLEY OF NEW MEXICO, AND CENTRAL ARIZONA, 1952-53 AND 1953-54 SEASONS

U. S. DEPARTMENT OF AGRICULTURE NEG. 4245-57 (6) AGRICULTURAL MARKETING SERVICE

Figure 4

per hour to run. It is also natural that these bigger plants should be able to gin faster, and thus turn out more bales in an hour. The question is whether the big plants gin sufficiently faster to offset their higher costs per hour of plant operation. The indicated answer is "Yes." The increased rate of output more than offset the higher costs per plant-hour so that costs per bale were lower for the elaborate gins.

Costs of operation for the elaborately equipped gins exceeded those of the simply equipped gins by $7 to $10 per plant-hour (table 21). However, the elaborately equipped gins were able to process 2.1 bales per plant-hour compared with 1.2 to 1.3 bales for the simply equipped gins. The result was that ginning costs per bale were $3 to $5 lower for the elaborately equipped gins than for the simply equipped group.

Ginning Revenue

The principal sources of revenue from ginning services were charges made to the farmer for ginning, bagging and ties, drying, and seed sterilization. At some gins, the latter two items were included in the basic ginning charge, while at other gins they were charged as separate items. Seed cotton drying service was available at most gins, but seed sterilization was practiced only in quarantined areas, where it was required. Charges for insurance and storage on baled cotton, which were assessed at the rate of about $1.05 per bale for the first 20 days, were not included. By the same token, yard expense, insurance, and other costs associated with the storage of baled cotton were excluded from the cost section of this bulletin. Because of the wide differences among gins in the length of time for which cotton was stored on the yard, it was felt that including data on storage would introduce an undesirable element of variability into both the cost and revenue figures.

The elaborately and moderately equipped gins of Texas and New Mexico realized average revenues of approximately $22 per bale during both years of the study (table 22). The moderately and simply equipped groups of Arizona had revenues of about $24 per bale during the 1952-53 season and $25 per bale during the 1953-54 season. Factors responsible for this regional difference in revenues appeared to be: (1) A higher scale of ginning charges at the Arizona gins, and (2) the fact that Arizona gins received a higher proportion of cotton which had been harvested by machine or by rough hand methods. This resulted in the ginning of a greater number of pounds of seed cotton for each bale of lint, and the earning of correspondingly greater fees for ginning and drying.

Table 21.--Production rates and ginning costs: American-Egyptian gins, by gin equipment group, 1952-53 and 1953-54

Season and item	Unit	Texas-New Mexico gins, equipped--		Central Arizona gins, equipped--	
		Elaborately	Moderately	Moderately	Simply
1952-53					
Cost per plant	Dollars	75,210	81,137	48,971	59,270
Plant operation time 1/	Hours	2,378	2,297	1,809	2,414
Bales ginned per plant	Number	4,994	4,720	2,230	2,965
Bales per plant hour 1/	Number	2.10	2.05	1.23	1.23
Cost per plant hour	Dollars	31.63	35.32	27.07	24.55
Cost per bale	Dollars	15.06	17.19	21.96	19.99
1953-54					
Cost per plant	Dollars	65,146	60,984	40,084	43,295
Plant operation time 1/	Hours	1,648	1,556	1,195	1,480
Bales ginned per plant	Number	3,456	3,208	1,567	1,952
Bales per plant hour 1/	Number	2.10	2.06	1.31	1.32
Cost per plant hour	Dollars	39.53	39.19	33.54	29.25
Cost per bale	Dollars	18.85	19.01	25.58	22.18

1/ Includes time consumed by stops resulting from normal gin operation.

Table 22.--Gross returns from ginning: Average per bale and per gin for American-Egyptian gins, by gin equipment group, 1952-53 and 1953-54

Season and source of revenue	Texas-New Mexico gins, equipped--				Central Arizona gins, equipped--			
	Elaborately		Moderately		Moderately		Simply	
	Per gin	Per bale	Per gin	Per bale	Per gin	Per bale	Per gin	Per bale
	Dol.	Dol.	Dol.	Dol.	Dol.	Dol.	Dol.	Dol.
1952-53								
Ginning services	85,664	17.15	81,874	17.35	46,399	20.81	61,695	20.81
Sale of bagging and ties	23,914	4.79	22,858	4.84	7,587	3.40	10,158	3.42
Total	109,578	21.94	104,732	22.19	53,986	24.21	71,853	24.23
Bales per gin (average)	4,994		4,720		2,230		2,965	
1953-54								
Ginning services	59,752	17.29	56,140	17.50	34,147	21.79	43,109	22.09
Sale of bagging and ties	16,502	4.77	16,037	5.00	5,404	3.45	6,523	3.34
Total	76,254	22.06	72,177	22.50	39,551	25.24	49,632	25.43
Bales per gin (average)	3,456		3,208		1,567		1,952	

Net Returns from Ginning

During the 1952-53 season the elaborately equipped gins fared the best in net returns both on a per gin and a per bale basis. This is because of advantages this group had in volume, speed of ginning, and other factors. Elaborately equipped gins with a net return of nearly $7 per bale were followed by the moderately equipped Texas-New Mexico group with a return of $5 per bale (table 23). The simply equipped Arizona gins were third with a net return of $4.24 per bale and the moderately equipped Arizona gins were last with a return of $2.25 per bale.

Table 23.--Ginning revenue, costs and net returns: Averages per bale and per gin for American-Egyptian cotton, by gin equipment group, 1952-53 and 1953-54

Season and item	Texas-New Mexico gins, equipped--				Central Arizona gins, equipped--			
	Elaborately		Moderately		Moderately		Simply	
	Per gin	Per bale	Per gin	Per bale	Per gin	Per bale	Per gin	Per bale
	Dol.	Dol.	Dol.	Dol.	Dol.	Dol.	Dol.	Dol.
1952-53								
Ginning revenue	109,578	21.94	104,732	22.19	53,986	24.21	71,853	24.23
Ginning cost	75,210	15.06	81,137	17.19	48,971	21.96	59,270	19.99
Net return	34,368	6.88	23,595	5.00	5,015	2.25	12,583	4.24
Bales per gin	4,994		4,720		2,230		2,965	
1953-54								
Ginning revenue	76,254	22.06	72,177	22.50	39,551	25.24	49,632	25.43
Ginning cost	65,146	18.85	60,984	19.01	40,084	25.58	43,295	22.18
Net return	11,108	3.21	11,193	3.49	- 533	- .34	6,337	3.25
Bales per gin	3,456		3,208		1,567		1,952	

During the 1953-54 season the moderately equipped Texas-New Mexico group enjoyed the highest return--about $3.50 per bale--followed by the elaborately and the simply equipped gins, each with about $3.25 per bale net return. The moderately equipped Arizona group, with average volumes of less than 1,600 bales per year, actually went "in the red" to the extent of 34 cents per bale if all costs were considered.

Break-even Points

The break-even point--the minimum number of bales which a plant must gin in a season in order for ginning revenues to equal ginning costs--is of utmost importance to the gin owner. At ginning volumes less than the break-even volume a gin will be operating at a loss, if all costs are considered; at volumes greater than the break-even volume, the gin business will earn a net profit. Because the elaborately and moderately equipped gins located in the Trans-Pecos area of Texas and the Mesilla Valley of New Mexico appeared to group together logically from the standpoint of both costs and revenue, they were combined for the purpose of estimating their average break-even volume. For similar reasons, the moderately and simply equipped gins located in Central Arizona were combined in order to estimate their break-even volume.

The average break-even volume for gins in Texas and New Mexico was approximately 2,750 bales (fig. 5). This is based upon a cost function obtained by fitting a line to the cost-volume coordinates for the individual gins included in these groups, and a revenue line based upon $22.15 per bale which was the average revenue earned by those gins during the 2 years of the study. All the Texas-New Mexico gins operated at volumes in excess of 2,750 bales during the 1952-53 season, but 2 gins fell slightly below the break-even volume during the 1953-54 season.

The average break-even volume for gins in Central Arizona, computed in the same manner, was about 1,750 bales (fig. 6). This is 1,000 bales less than that required for gins in the Texas-New Mexico groups. Two principal reasons for the lower break-even volume required by the Arizona gins are: (1) The lower capital investment in plant and machinery in the gins, which results in lower fixed costs, and (2) the higher ginning revenues per bale--$24.66 per bale as compared with $22.15 per bale charged at the Texas-New Mexico gins.

During the 1952-53 season, only 1 gin out of the 6 in the Arizona group operated at a volume of less than 1,750 bales, but 2 gins operated at volumes only slightly beyond this break-even point. The other 3 gins enjoyed substantially greater volumes during that season. During the 1953-54 season, 3 out of the 6 gins operated at volumes less than 1,750 bales, while the remaining 3 operated at volumes only slightly beyond this critical point.

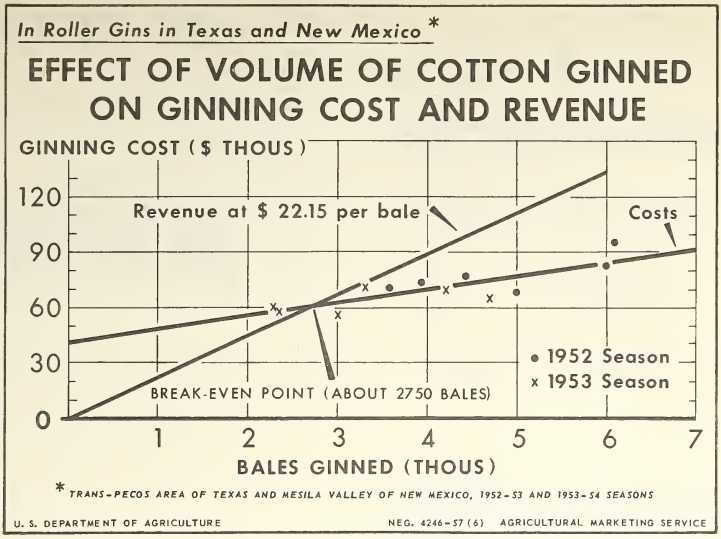


Figure 5

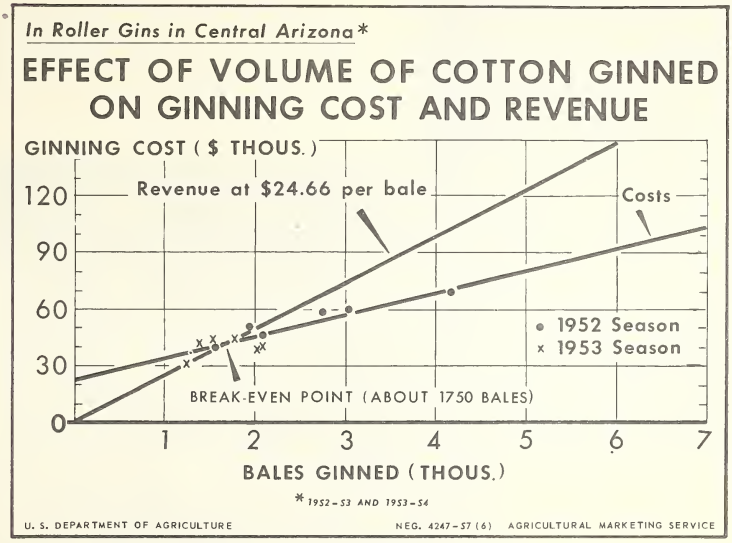


Figure 6

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